Space Weather Technical Forecast

Issued on Wednesday 5 February 2025 at 00:08 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of a glancing blow from a CME day 2 (06 Feb). Further M-class flares expected, slight chance of an X-class flare.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was moderate over the past 24 hours, with fairly frequent M-class flares, most of which originated from AR3981. The strongest recorded was an M4.7 flare, peaking at 04/1121 UTC.

There are eight active regions on the Earth-facing disc, with AR3982 having faded. The majority of the activity is from the broad cluster of sunspots in the north extending from central disc into the western hemisphere, and consisting of AR3976, AR3977, AR3978, AR3981and AR3984. These form a rather large and complex area of multiple bipolar active regions, with signs of magnetic interaction between the regions suggesting the ongoing potential for notable flares. AR3976, AR3977, AR3978 and AR3984 continue to slowly evolve, and mostly showing recent slight decay. AR3981 meanwhile continues to increase in overall areal extent, and has two delta configurations within its intermediate and trailer spots. This region continues to produce the majority of the flare activity, including the largest M-class flare of the period. The remaining spots, are small and simple.

No Earth directed CMEs (coronal mass ejections) were observed in available imagery in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE at L1 showed a gradual decline from an average of 450 km/s to near 400 km/s. Density was below average or average. The Interplanetary Magnetic Field, Bt, was weak. The north-south component, Bz, was largely weakly positive. Phi angle was mainly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 was at background levels. High energy electron flux (greater than 2MeV) at GOES16 was at background to moderate levels, peaking at 319 pfu. The associated 24-hour fluence persisted below the Active threshold, recording 9.15e6 integrated pfu at 05/0000UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Moderate activity is forecast, with M-class flares expected at times and a slight chance of isolated X-class flares, primarily from the regions in the north spanning centre disc into the western hemisphere.

Solar Wind / Geomagnetic Activity: A CME associated with an M4.1 flare late on 02 Feb may give a glancing blow with Earth on the morning of day 2 (06 Feb), although this is low confidence. The potential for further CMEs is elevated.

Solar wind speeds are expected to continue generally at or near background levels for much of the period, but may return to slightly elevated or elevated levels for a time on day 2 (06 Feb), following any potential CME arrival. The high speed stream of CH13/- is expected to most likely arrive at Earth beyond the current forecast period, although there is a chance it may become geoeffective later day 4 (08 Feb).

Generally Quiet (Kp 0-2) geomagnetic activity is expected for much of the period. However, there is a chance following any potential CME arrival on day 2, of seeing activity temporarily increase to G1-G2/Minor-Moderate Geomagnetic Storm intervals (Kp 5-6). Also, later day 4 there is a slight chance for G1/Minor Storm conditions to develop should the next high speed stream arrive.

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is likely to be at background levels, but with a slightly increasing potential of responding to any notable flares as the sunspot regions in the north move further into the western hemisphere. High energy electron flux observed at GOES16 has recently remained at Moderate levels. This is expected to persist, with a chance of becoming briefly diurnally High. The corresponding 24 hour fluence is expected to persist below the Active threshold.

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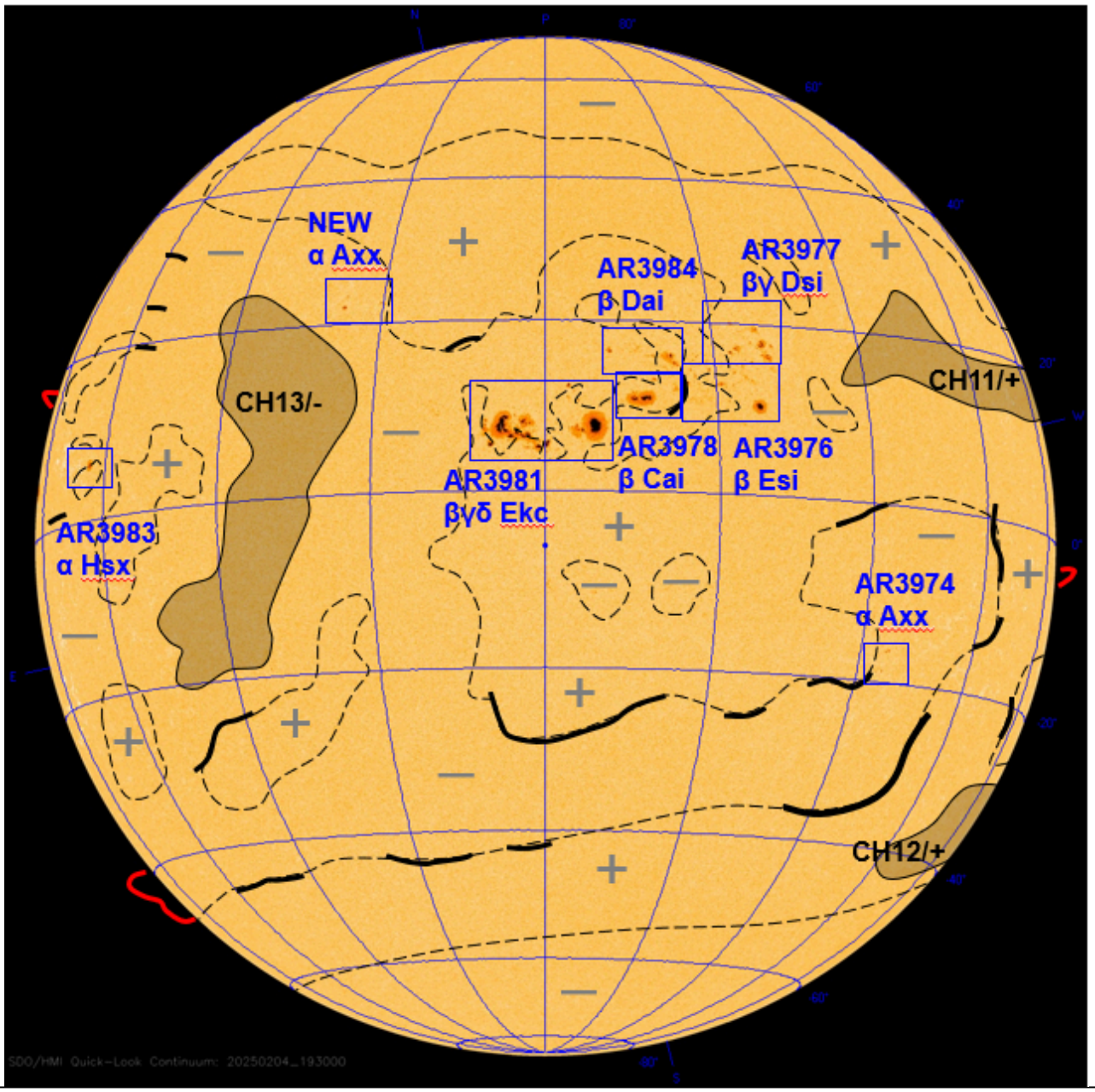
Figure 1: Solar synoptic map valid 04/1945UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

One CME currently features in the forecast, a faint CME associated with an M4.1 flare at 02/2320 UTC from AR3981. This CME was faint and occurred at a similar time as a larger, far-sided CME, which lowers the confidence of analysis. However there is a possibility the CME could make a glancing impact with Earth on the morning of day 2 (06 Feb). The potential for further CMEs also remains elevated, with a number of large filaments in potentially geoeffective positions and the large cluster of the sunspots to the north currently rotating into and across the western hemisphere.

Solar wind speeds have declined to near background, currently around 400km/s, following recent coronal hole connection. Solar wind speeds are expected to continue generally at or near background levels for much of the period, although could perhaps return to slightly elevated or elevated levels for a time on day 2 (06 Feb), following any potential CME arrival. The high speed stream of CH13/- is expected to most likely arrive at Earth beyond the current forecast period, although there is a chance it may become geoeffective later day 4 (08 Feb). MOSWOC ENLILs solar wind speeds are considered generally well modelled, but perhaps a little early with the onset of the next high speed stream.

Generally Quiet (Kp 0-2) geomagnetic activity is expected for much of the period. However, there is a chance following any potential CME arrival on day 2, of seeing activity temporarily increase to G1-G2/Minor-Moderate Geomagnetic Storm intervals (Kp 5-6). Also, later day 4 there is a slight chance for G1/Minor Storm conditions to develop should the next high speed stream arrive.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	40	20	20
Strong	G3	No	1	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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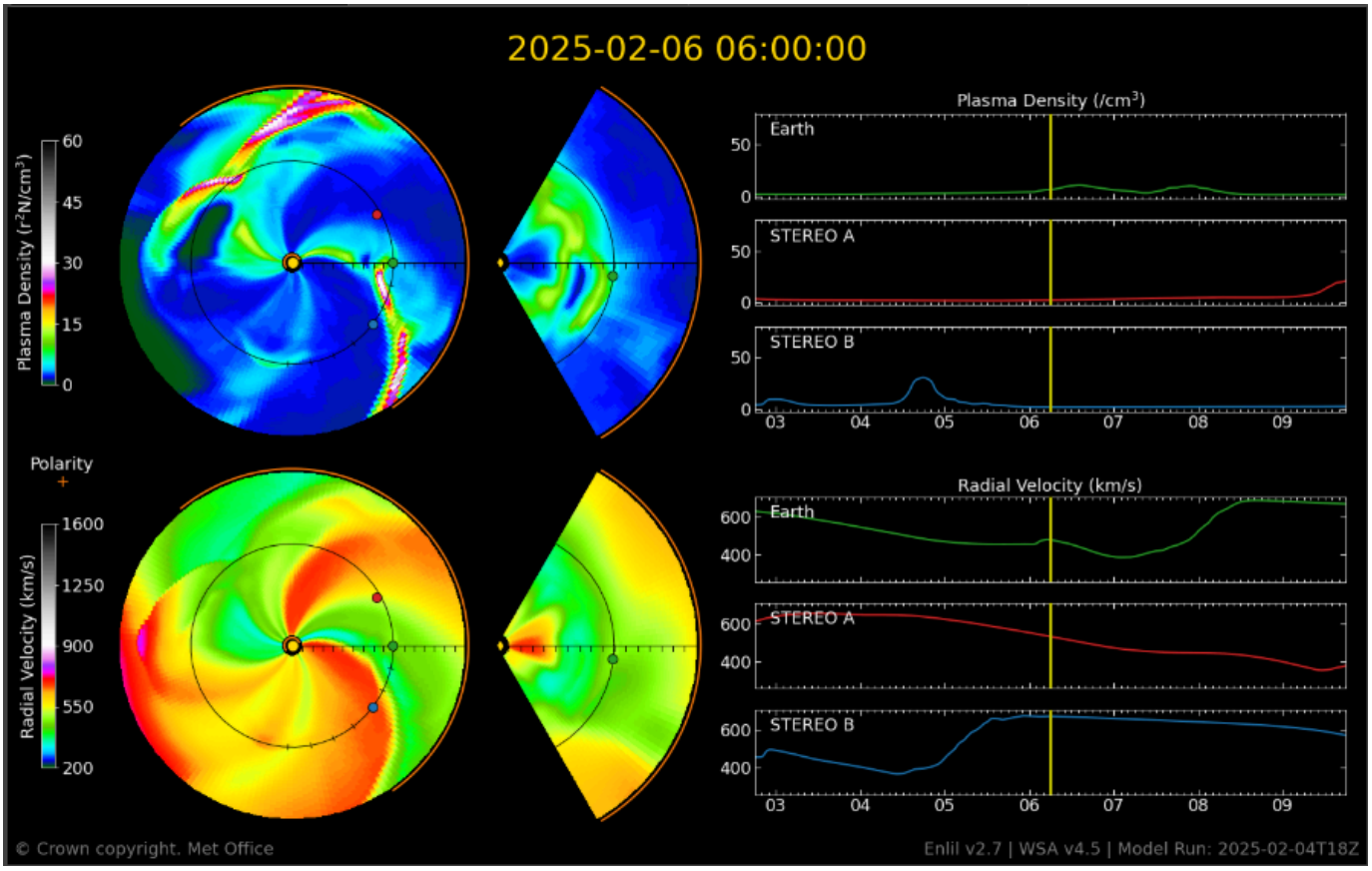
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
03/0457	Partial	AR3981	NE	590	06/0700 +/- 6 hours	Chance of glancing impact, but low confidence.

Figure 2: MOSWOC ENLIL



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Radio Blackouts - X-Ray Flares

Solar activity was moderate over the past 24 hours, with fairly frequent M-class flares, most of which originated from AR3981. The strongest recorded was an M4.7 flare, peaking at 04/1121 UTC.

There are eight active regions on the Earth-facing disc, with AR3982 having faded. The majority of the activity is from the broad cluster of sunspots in the north extending from central disc into the western hemisphere, and consisting of AR3976, AR3977, AR3978, AR3981and AR3984. These form a rather large and complex area of multiple bipolar active regions, with signs of magnetic interaction between the regions suggesting the ongoing potential for notable flares. AR3976, AR3977, AR3978 and AR3984 continue to slowly evolve, and mostly showing recent slight decay. AR3981 meanwhile continues to increase in overall areal extent, and has two delta configurations within its intermediate and trailer spots. This region continues to produce the majority of the flare activity, including the largest M-class flare of the period. The remaining spots, are small and simple.

Further M-class flares are anticipated, primarily from AR3981 or a nearby region, with a slight chance of an X-class flare.

No significant regions are due to rotate off the disc in the forecast period. Recurrence suggests the potential for returning regions during the period, although far-side helioseismic output has no strong signals in the short term.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	80	80	80
Very Active	R3-R5 (X Class)	No	20	20	20	20

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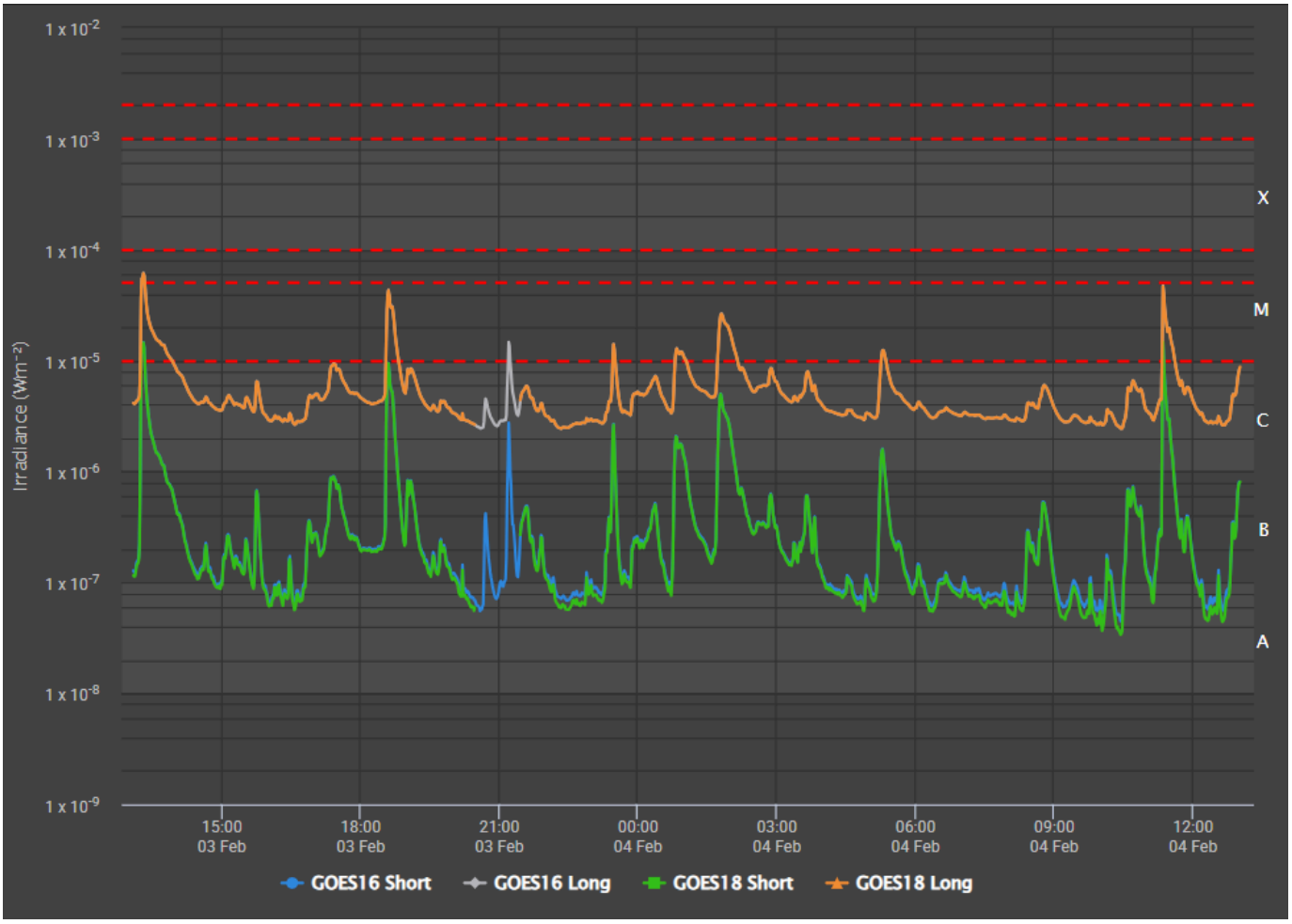
Figure 3: 24 hour X-Ray trace.



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Solar Radiation Storms (High Energy Protons)

Proton flux as observed by GOES-18 is currently at background levels, and is generally likely to remain that way, at least at first. As the large cluster of sunspots in the north move further across the western hemisphere, there is a gradually increasing chance of proton flux rising in response to any notable flares.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	25	30	30
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has recently remained at Moderate levels. Given the lack of geomagnetic activity recently, the Van Allen belts are unlikely to be sufficiently charged to bring a dramatic increase in flux in coming days, with just a chance of becoming briefly diurnally High.

The corresponding 24 hour fluence is expected to persist below the Active threshold. MOSWOC REFM output is currently thought to be providing reasonable guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	5	5	5	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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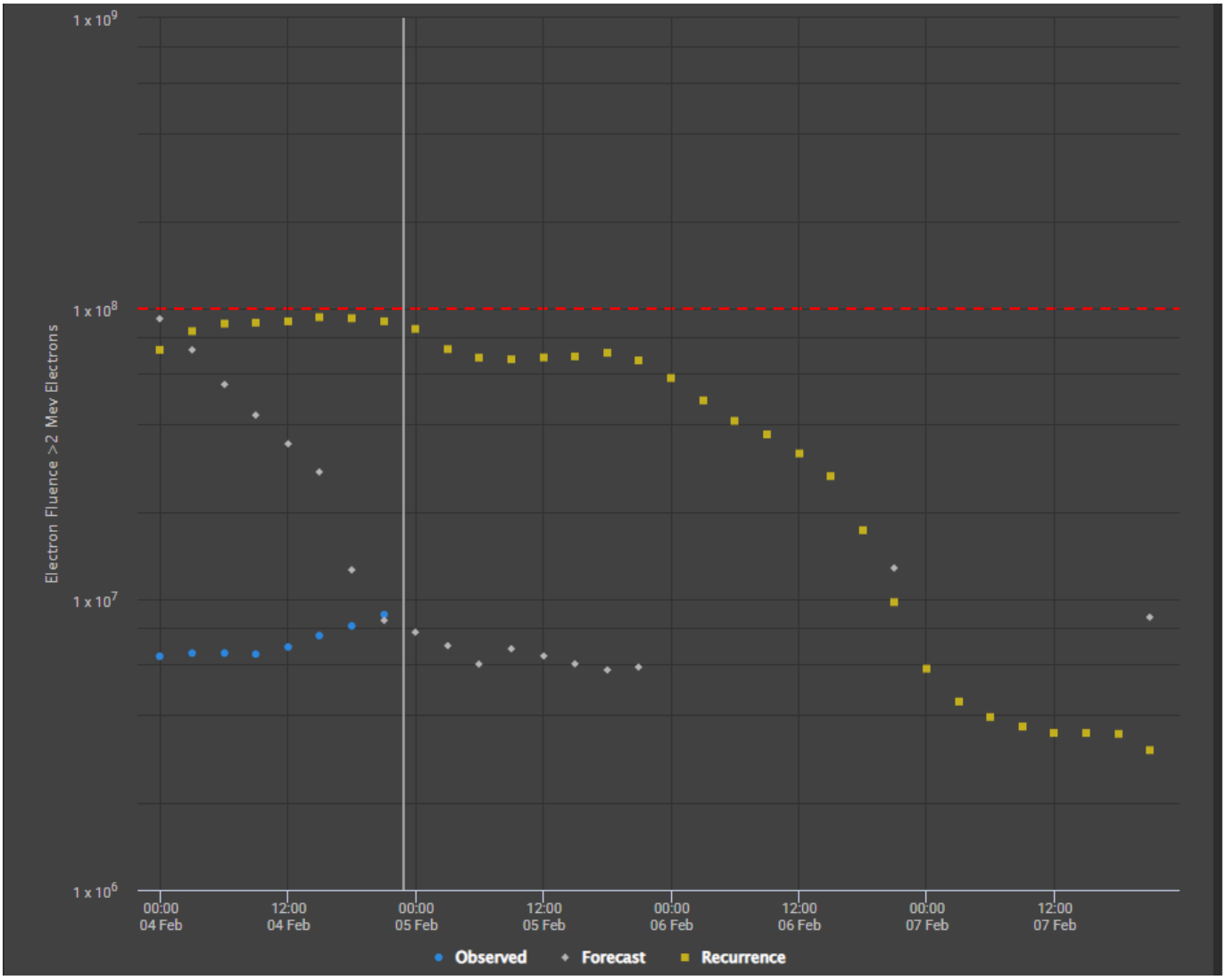
Figure 4: MOSWOC REFM integrated flux/fluence forecast, recurrence and observations.



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